

REMARKS

Reconsideration and allowance of the present patent application based on the following remarks are respectfully requested. Since this Amendment is being presented together with a Request for Continued Examination, entry of this Amendment is respectfully requested.

By this Amendment, the specification and claims 1 and 4 are amended. The specification is amended to add the priority information. No new matter has been added. Accordingly, after entry of this Response, claims 1-14 will remain pending in the patent application.

Claims 1-6 and 13 were rejected under 35 U.S.C. §103(a) based on Kutsunai *et al.* (U.S. Pub. No. 2002/0055223) (hereinafter "Kutsunai") in view of Buchanan *et al.* (U.S. Pat. No. 6,984,591) (hereinafter "Buchanan"). The rejection is respectfully traversed.

Claim 1 recites a barrier structure for copper metallization, comprising "a dielectric pattern disposed directly on an upper surface of a substrate; a first Ru layer disposed directly on an upper surface of the dielectric pattern; an oxide film disposed directly on an upper surface of the first Ru layer; a second Ru layer disposed directly on an upper surface of the oxide film; and a Cu layer disposed directly on an upper surface of the second Ru layer." It is respectfully submitted that the combination of Kutsunai and Buchanan fails to present a *prima facie* case of obviousness.

By way of review, Kutsunai discloses an impurity diffusion layer including, sequentially, an oxygen barrier layer 108A (identified by the Office Action as the "Cu layer" of claim 1) that may comprise copper, a first upper oxygen barrier 114A (identified by the Office Action as the "first Ru layer" of claim 1) that may include Ru, a second upper oxygen barrier layer 115A (identified by the Office Action as the "oxide film" of claim 1) and a capacitor lower electrode 110A (identified by the Office Action as the "second Ru layer" of claim 1). (See, e.g., paragraphs 94-100 and FIGS. 1A-C of Kutsunai). The impurity diffusion layer is provided on an insulating film 103 (identified by the Office Action as the "dielectric pattern" of claim 1). *Id.*

Buchanan discloses a trench capacitor that includes, sequentially, a conductive barrier layer 32, a bottom electrode 33, a dielectric layer 34 and a top electrode 35. (See, e.g., FIG. 30 and col. 27, lines 21-67 and col. 28, lines 1-39 of Buchanan).

Having said this, it is respectfully submitted that there is absolutely nothing in Kutsunai, Buchanan and any combination thereof that remotely discloses, teaches or suggests *each and every limitation* of claim 1, including the features identified above.

As conceded by the Office Action, Kutsunai fails to disclose, teach or suggest a second Ru layer in contact with the oxide film. However, Applicant respectfully submits that there are additional features that are absent in Kutsunai.

For example, Kutsunai is silent as to a Cu layer formed directly on the second Ru layer. Unlike claim 1, Kutsunai merely discloses that oxygen barrier layer 108A (identified by the Office Action as the “Cu layer” of claim 1) is formed directly on an insulating film 103 (identified by the Office Action as the “dielectric pattern” of claim 1), not on the capacitor lower electrode 110A (identified by the Office Action as the “second Ru layer” of claim 1). The only layer of Kutsunai that is formed on the layer 110A is layer 112A. (See, e.g. FIG. 3C of Kutsunai). However, in contrast to claim 1, layer 112A is not a Cu layer. Rather, Kutsunai discloses that layer 112A is a capacitor dielectric film. (See, e.g., paragraph 97 of Kutsunai).

As another example, Kutsunai is silent as to a first Ru layer disposed directly on an upper surface of the dielectric pattern. Unlike claim 1, Kutsunai merely discloses that the first upper oxygen barrier 114A (identified by the Office Action as the “first Ru layer” of claim 1) is disposed directly on the oxygen barrier layer 108A (identified by the Office Action as the “Cu layer” of claim 1), not on the insulating film 103 (identified by the Office Action as the “dielectric pattern” of claim 1).

Buchanan fails to remedy the deficiencies of Kutsunai. Buchanan was merely cited as disclosing the use of Ruthenium to manufacture a lower capacitor electrode. Neither Kutsunai nor Buchanan discloses, teaches or suggests a barrier structure for copper metallization, comprising, sequentially, a dielectric pattern disposed directly on an upper surface of a substrate; a first Ru layer disposed directly on an upper surface of the dielectric pattern; an oxide film disposed directly on an upper surface of the first Ru layer; a second Ru layer disposed directly on an upper surface of the oxide film; and a Cu layer disposed directly on an upper surface of the second Ru layer. As such, any reasonable combination of Kutsunai and Buchanan cannot result, in any way, in the invention of claim 1.

Claims 2-6 and 13 are patentable over Aggarwal, Buchanan and any proper reasonable combination thereof at least by virtue of their dependency from claim 1 and for the additional features recited therein.

Accordingly, reconsideration and withdrawal of the rejection of claims 1-6 and 13 under 35 U.S.C. §103(a) based on Kutsunai in view of Buchanan are respectfully requested.

Claims 1-6 and 13 were rejected under 35 U.S.C. §103(a) based on Aggarwal *et al.* (U.S. Pat. No. 6,635,497) (hereinafter “Aggarwal”) in view of Buchanan. The rejection is respectfully traversed.

Claim 1 is recited above. By way of review, Aggarwal discloses a structure that includes, sequentially, a dielectric 112 formed over a substrate 102, a barrier 116, a Cu plug 114 and a barrier layer 122. (See, e.g., FIGS. 5a-h, FIG. 17 and col. 8, lines 48-67 and col. 10, lines 21-62 of Aggarwal). Aggarwal also discloses forming a FeRAM capacitor on the barrier layer 112. *Id.*

As conceded by the Office Action, Aggarwal fails to disclose, teach or suggest a first Ru layer formed on the dielectric pattern, an oxide film formed on an upper part of the first Ru layer and a second Ru layer formed on the oxide film. The Examiner relies on Kutsunai as allegedly disclosing these features and asserts that it would have obvious to substitute Ruthenium for Iridium. Applicant strenuously disagrees and submits that there are additional features that are absent in Aggarwal.

For example, Aggarwal is silent as to a Cu layer formed on the second Ru layer. Aggarwal merely discloses that the stack of material that includes, sequentially, Iridium, Iridium oxide and Iridium, which stack has been identified by the Office Action as, respectively, the “first Ru layer disposed directly on an upper surface of the dielectric pattern; an oxide film disposed directly on an upper surface of the first Ru layer; a second Ru layer disposed directly on an upper surface of the oxide film”, is directly formed on the barrier layer 112, not on the Cu plug 114. (See, e.g., FIGS. 5a-h, FIG. 17 and col. 8, lines 48-67 and col. 10, lines 21-62 and col. 28, lines 53-67 and col. 29, lines 1-18 of Aggarwal). In doing so, and unlike claim 1, Aggarwal does not disclose, teach or suggest a Cu layer disposed directly on an upper surface of the second Ru layer.

Kutsunai fails to remedy the deficiencies of Aggarwal. As noted above, Kutsunai is silent as to a Cu layer formed directly on the second Ru layer. Accordingly, any proper combination of Aggarwal and Kutsunai cannot result, in any way, in the invention of claim 1.

Claims 2-6 and 13 are patentable over Aggarwal, Buchanan and any proper reasonable combination thereof at least by virtue of their dependency from claim 1 and for the additional features recited therein.

As mentioned previously, Kutsunai fails to remedy the deficiencies of Aggarwal. As such, any reasonable combination of Aggarwal and Kutsunai cannot result, in any way, in the invention of claim 1.

Claims 2-6 and 13 are patentable over Aggarwal, Kutsunai and any proper reasonable combination thereof at least by virtue of their dependency from claim 1 and for the additional features recited therein.

Accordingly, reconsideration and withdrawal of the rejection of claims 1-6 and 13 under 35 U.S.C. §103(a) based on Aggarwal and Kutsunai are respectfully requested.

In view of the foregoing, the claims are now believed to be in form for allowance, and such action is hereby solicited. If any point remains in issue which the Examiner feels may be best resolved through a personal or telephone interview, please contact the undersigned at the telephone number listed below.

Please charge any fees associated with the submission of this paper to Deposit Account Number 033975. The Commissioner for Patents is also authorized to credit any over payments to the above-referenced Deposit Account.

Respectfully submitted,

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